A second software set resides upon the vessel within the computer **562** and is organized into several components. First, there is a data acquisition and real time display package. This software component polls the sensors at a frequency determined elsewhere and accumulates acquired data to temporary storage prior to telemetry and local display. The local display part of this component permits networked computers on vessel **16** to graph and display, either in real time or from historical databases, time series plots of measured variables in a very flexible manner. Second, there is a data acquisition/system management program. This component receives instructions via satellite regarding system management and control. Functions controlled include, putting computer system in and out of standby condition, starting system pump, initiating adaptive operations based upon values of measured variables initiating and controlling calibration and anti-fouling cycles. Third, there is a data telemetry and management message reception software component. This component manages the compression and formatting of outgoing binary messages and decodes and implements the incoming management data.

Software also permits two-way communication with sampling apparatus **10** so that the Module can be given instructions, new testing protocols, etc. This two-way communication feature is very different to anything to be found upon existing water monitoring devices such as on current drifters, buoys and research ships that offer only one-way communications and therefore cannot be directed controlled, adjusted or calibrated remotely.

Finally, the overall data system includes a set of decision trees that allow the system to respond to events or spikes reflected in the data being collected and transmitted. More routine data systems involve the storage of data and the reporting of events to nodes. In the data system, however, if a toxic algal bloom or a plume event is detected the data system will initialize a response by contacting appropriate users or sites while at the same time contacting sampling apparatus **10** producing the data requesting it to re-run samples or retest an area. Similarly, when detected wind speeds exceed a certain level the system is programmed to sample and transmit all weather data every hour rather than every three hours which is the normal interval for weather forecast modeling.

FIG. **19** illustrates an overall system of the present invention, including vessels **16**, which take data at various locations around the world. For example, sampling apparatus **10** may be employed on a variety of ocean and lake going vessels including research ships, cruise ships, naval ships, trawlers, fishing boats, and tankers. It may also be deployed on buoys, piers and other platforms. Each of sampling apparatus **10** (e.g., on vessels **16**) may transmit their data via satellites **2** to a central computer **3**. That data may then be accessed by parties **4** interested in analyzing that data. In addition, central computer **3** may send signals to any individual sampling apparatus **10** to take particular measurements when vessel **16** enters a particular global region.

The primary purpose of the above uses will be to generate significant new data on the oceans conditions to be used for improved weather forecasting, enhanced climatic change monitoring, education (GLOBE program) and improved fisheries management. The data will also be used to ground truth data from ocean sensors on orbiting satellites, and to assist in the calibration of such sensors.

Finally, it is contemplated that sampling apparatus **10** may be used on oil drilling platforms, in aquaculture facilities (to detect changes in salinity levels, the presence of preconditions to toxic algal blooms, and other conditions hazardous to sea life), to monitor fresh water lakes, rivers, streams, and reservoirs (for algae and bacterial growth), to monitor sewer out falls, storm drains, and other ocean discharge sources for heavy metal contamination, to monitor pollution in harbors, to monitor sanitary conditions in public swimming pools, and to monitor waste water treatment facilities and holding tanks.

While specific embodiments of the present invention have been disclosed, those skilled in the art will readily recognize that many of the components described and illustrated may be substituted with similar components without deviating from the scope and spirit of the present invention. Accordingly, it is intended that the claims appended hereto encompass all equivalents thereto and are not limited by the embodiments disclosed herein.

What is claimed is:

1. A water sampling apparatus, comprising:

a water inlet;

a pump, in fluid communication with the water inlet, for drawing a water sample from a body of water through the water inlet;

a plurality of plug-in testing units, in fluid communication with the pump and the water inlet, for determining characteristics of a the water sample, the plurality of plug-in testing units being contained within a dry instrument module;

a plurality of electrical components, in communication at least with some of the plurality of plug-in testing units, for generating data signals concerning the characteristics of the water sample, the plurality of electrical components being contained within a computer module;

a computer, in communication at least with some of the plurality of electrical components, for collecting the data signals generated by the plurality of electrical components and for providing the data signals to a database; and

a water outlet, in fluid communication with the plurality of plug-in testing units, for returning the water sample to the body of water.

2. The sampling apparatus of claim **1**, wherein the computer is located within the computer module.

3. The sampling apparatus of claim **1**, wherein the database is located in at least one of a memory in the computer or a memory in a computer located remotely from the sampling apparatus.

4. The sampling apparatus of claim **1**, wherein the plurality of plug-in testing units determine characteristics for at least one of salinity, water temperature, dissolved oxygen content, pH, Eh, Chlorophyll content, CDOM, turbidity, meteorological conditions, global position, bioluminescence, toxic metal content, phosphate content, silicate, pCO_2, biochemical content, ozone content, and solar radiation.

5. The sampling apparatus of claim **4**, wherein the plurality of plug-in testing units operate autonomously according to a predetermined program within the computer.

6. The sampling apparatus of claim **1**, wherein the computer automatically periodically calibrates the plurality of plug-in testing units to compensate for measurement error.

7. The sampling apparatus of claim **1**, wherein the computer automatically and periodically performs a n anti-fouling operation to minimize accumulation of biofouling agents.